Key data from some British nuclear weapon trial research reports

Nigel B. Cook

Displacement of objects by blast waves

The overpressure of the blast wave acts in *all directions* on an object once the blast wave front has travelled, at supersonic velocity, across the object. Hence, the forces upon an object are rapidly equalised from all directions, so although there is a compression force, there is little net displacement caused by the overpressure.

However, the blast winds or *dynamic pressure* which acts specifically in the direction of the blast wave, can cause drag. The maximum velocity which a free object of mass m, drag coefficient C, and cross-sectional area A, will attain in a blast wind with dynamic pressure impulse (pressure integrated over time) I, is: v = CAI/m. This is valid for glass fragments from shattered windows, displaced men, roof tiles, and debris. (Momentum mv = CAI.)

If there is friction involved, for example the rolling resistance, F, for a Land Rover hit end-on by a blast wave, the displacement distance X will be determined by the resistance, since the work energy E = FX, needed to overcome the rolling resistance for distance X will equal the initial kinetic energy E = (1/2) mv^2, simply because the car will continue rolling (after being pushed by the blast wave) until rolling resistance brings it to a half, so we can assume that all the kinetic energy is converted into heat of friction due to rolling resistance.

Hence, E = (1/2) mv^2 = FX, so: X = (mv^2)/(2F). For a typical 1,200 kg car (Land Rover) on concrete, the rolling friction resistance force (with brakes off, in neutral gear) is F = 200 Newtons, the head-on cross-sectional area of the Land Rover is 2.64 m^2, and the effective drag coefficient for a Landrover car face-on to a blast wave wind is C = 0.2. Hence, the displacement of a car hit head-on by a blast wave will be: X = (mv^2)/(2F) = [m(CAI/m)^2]/(2F) = [(CAI)^2]/(2Fm) = 0.000,000,58 I^2 metres.

At the Totem-1 British nuclear test at Emu Field, Australia, this actual experiment was done in 1953 using a 10 kt nuclear bomb and the Land Rover described above, exposed head-on to the blast with "gear lever in neutral and the hand brake off." (E. R. Drake Seager and R. F. C. Butler, *Effects on a Landrover (Car 5 cwt, 4x4) and Generating Sets,* Operation Totem, Atomic Weapons Research Establishment, Aldermaston, report T79/54, Secret-Guard, 1956.)

The car was exposed to a peak overpressure of 90 kPa and was badly dented by overpressure crushing; it was also moved back by 3.0 metres by the blast winds, but it could be used. The dynamic pressure impulse was 2400 Pa-sec. Using our formula above, this 3 m displacement is indeed predicted by theory.

Blast effects on standing personnel

In 1948, R. H. A Liston of the Atomic Research Establishment, UK, did a theoretical study of the displacement of man by a blast wave (*The kinematic effect of blast on a man in the open,* ARE Report 1/48), in which he assumed a drag coefficient for a standing man of 0.8, and predicted that a standing 76 kg man would be displaced 20 ft by a blast of 7 psi peak overpressure from a 20 kt bomb, which he assumed to occur 1.2 km from ground zero. For a peak overpressure of 3 psi, he predicted a displacement of 4 ft.

The importance of the displacement of man by long-duration nuclear blasts, as opposed to the short duration TNT (non-nuclear) bomb blast, was recognised by the British War Office in 1955, who arranged extensive experiments at the British nuclear tests, Operation Buffalo, in 1956, as well as Operation Antler 1n 1957, using dummies standing, kneeling, lying down, and in vehicles and shelters, to obtain precise information; and the Americans did some limited but cine-camera filmed exposure of dummies to 2 nuclear explosions during Operation Plumbbob, Nevada, in 1957.

The 1955 secret planning document, *Operation BUFFALO Target Response Trials, Biological Sub-committee, Provisional Plan for Field Trial Submitted by War Office: Displacement Effects of Atomic Blast,* notes: "An Army in the field is bound to have certain numbers of men who are always exposed in the open. It is possible to protect these men from the effects of thermal radiation, and it is then desirable to know the ranges at which thermally protected men will be injured by displacement from the effects of the blast wave."

Buffalo-One Tree 15 kt burst atop a 100 ft aluminium tower, 27 September 1956: basic nuclear weapons effects data

SOURCE: W. J. H. Butterfield et al, "The Effects of Blast on Dummy Men Exposed in the Open", Operation Buffalo, report AWRE-T2/59 (1959).

The heat flash "popcorning" of the ground "began to subside 1.5 seconds after burst"

Peak overpressure				Displacements of standing dummies (feet) located on "soft ground"	
(psi)	Gamma (rads)	Thermal (cal/cm^2)	Distance (ft)	*Facing burst*	*Sideways to burst*
10	-	38	2400	34	20
8.5	-	31		30	16
6.4	2000	23		16	10
4.3	340	14	3900	4	3
2.4	17	5.8		2	0

Buffalo-One Tree 15 kt burst atop a 100 ft aluminium tower, 27 September 1956: detailed blast wave data

SOURCE: W. J. H. Butterfield et al, "The Effects of Blast on Dummy Men Exposed in the Open", Operation Buffalo, report AWRE-T2/59 (1959).

Ground range (ft)	Peak o/p (psi)	+phase o/p duration (sec)	time of arrival (sec)
1100 ft	40	0.34	0.22
1230	31	0.36	0.28
1360	27	0.39	0.34
1450	24	0.41	0.40
1600	21	0.44	0.48
1750	19.5	0.46	0.58
1850	18	0.48	0.63
2000	15	0.51	0.72
2200	12	0.54	0.86
2400	10	0.57	1.0
2700	8.1	0.61	1.2
3400	5.4	0.69	1.8
3900	4.3	0.75	2.2
4200	3.9	0.78	2.4
4600	3.4	0.81	2.7

BRITISH NUCLEAR TESTS: OPERATION ANTLER, MARALINGA, 1957

A. R. F. Martin, "The effects of blast on dummies and scout cars", Operation Antler, Atomic Weapons Research Establishment, Aldermaston, UK, Report T6/59 (1959)

ROUND 2: Antler-Biak test, 25 Sept 1957, 6 kt tower shot at Maralinga: 30 dummies in the open & 4 in Daimler Scout Cars.

ROUND 3: Antler-Taranaki test, 9 Oct 1957, 25 kt balloon shot at Maralinga: "On Round 3, pairs of dummies were exposed in each of 8 Champ vehicles (¼ ton, 4x4 vehicles) and 6 further dummies exposed in the open as controls at the 3 nearestin positions. Because of the presence of a precursor, all these dummies suffered severe damage."

Dummies were 6ft 1 in tall and 175 lb in mass, dressed in white overalls to reflect heat and prevent ignition by heat flash, with steel helmets on those prone and crouching (but not standing), "at Operation Buffalo, steel helmets worn with the strap under the chin were found to present serious hazard to the wearer when exposed to the blast."

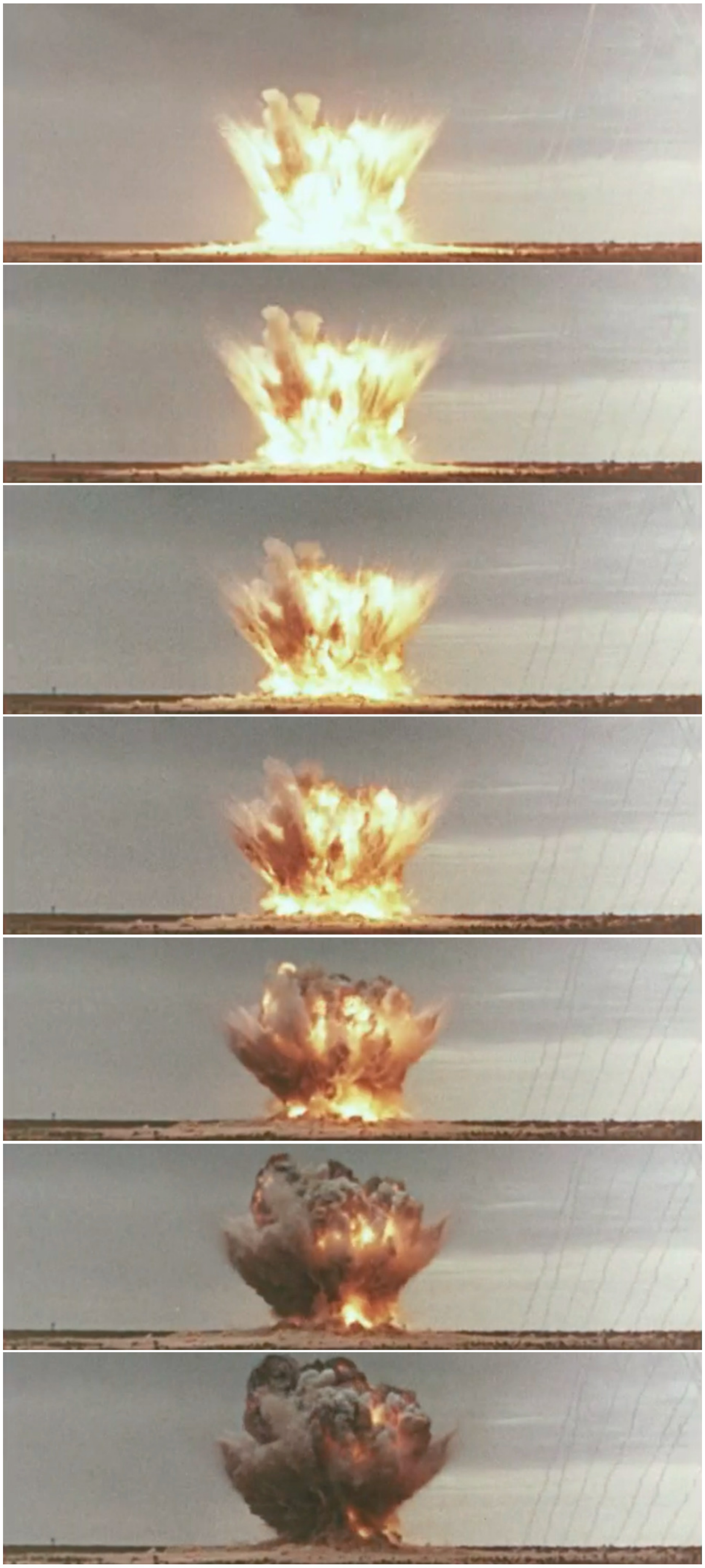
Loose helmets on "soldiers" heads at Antler R2 : 4psi peak o/p, helmet displaced 66 ft; 2.8psi, 15 ft.

Daimler Scout Car *side-on* at 1730 ft from Antler R2 (11 psi peak o/p): no significant displacement, but it was *turned on its side.* In other similar scout cars at 2200, 2530, and 2650 ft (7.0, 5.6 and 5.1 psi peak overpressure), there was no displacement at all:

Antler R2:

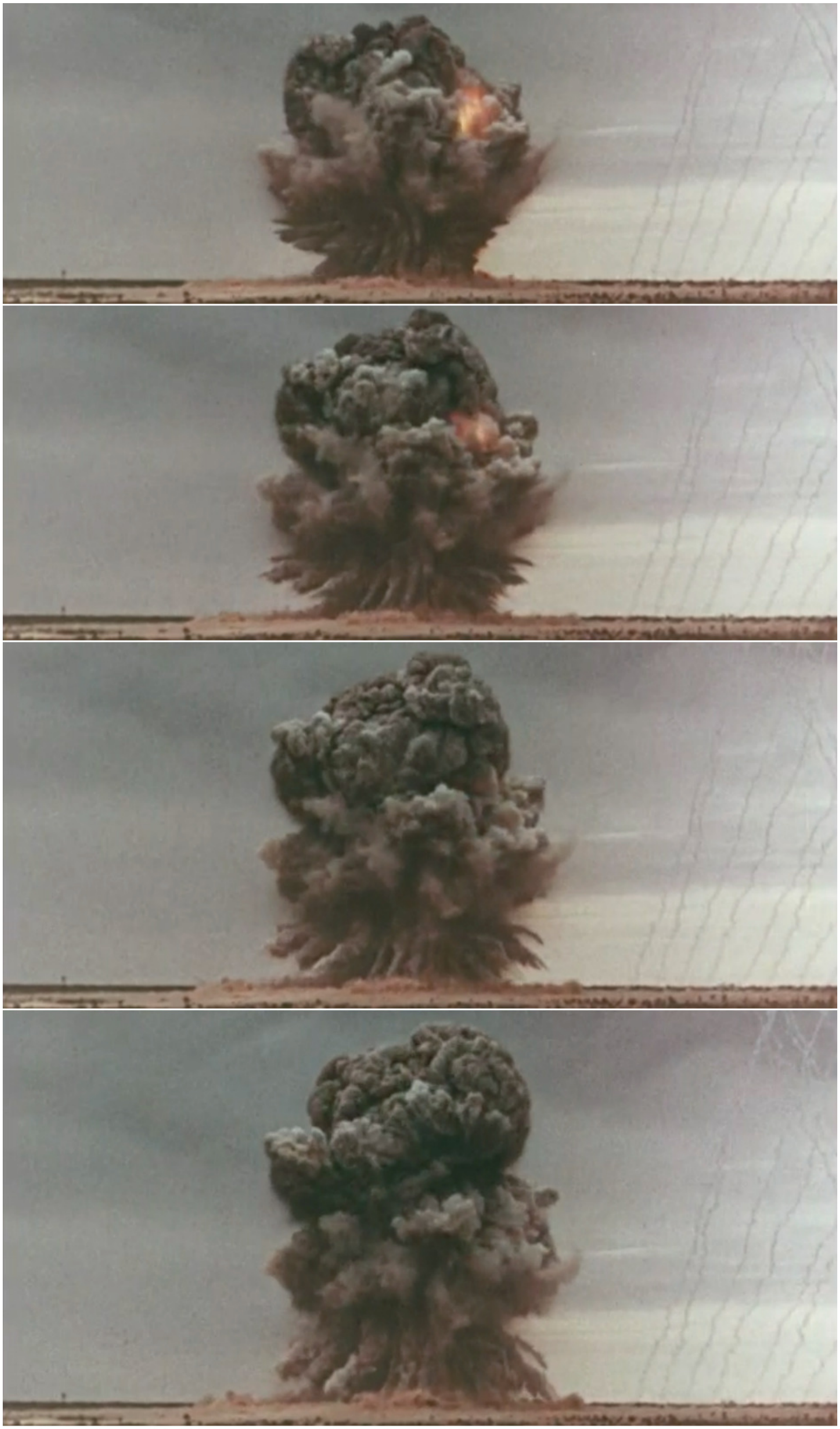
Distance from GZ (ft)	Thermal (cal/cm^2)	Effects on Daimler Cars
1730	43.5	Paint facing GZ scorched, "tyres slightly charred"
2200	27	Paint facing GZ scorched, "tyres slightly charred"
2530	20	Paint facing GZ scorched
2650	18.7	Paint facing GZ scorched

Buffalo 1, 15 kt burst atop 100 ft aluminium tower, Maralinga, 27 September 1956

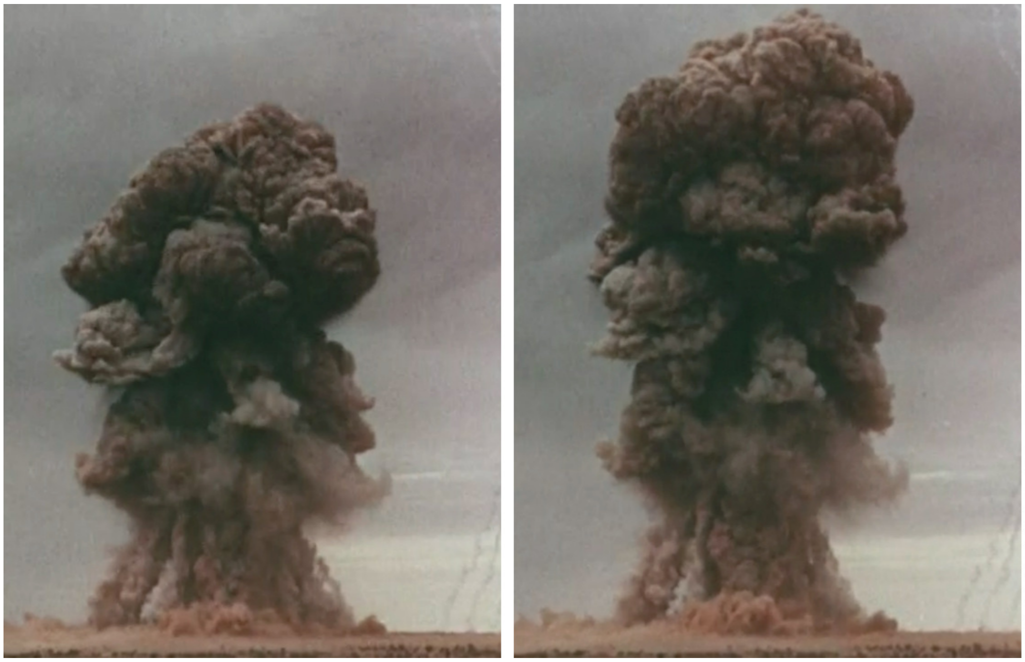


1.4 kt Buffalo-2 surface burst, Marcoo site, Maralinga, 1956. Crater ejecta screens fireball.

Buffalo 2 cratering & fireball



1.4 kt Buffalo-2 surface burst, Maralinga. Notice trajectories of crater throwout streams.



1.4 kt Buffalo 2 cloud rise and mixing.

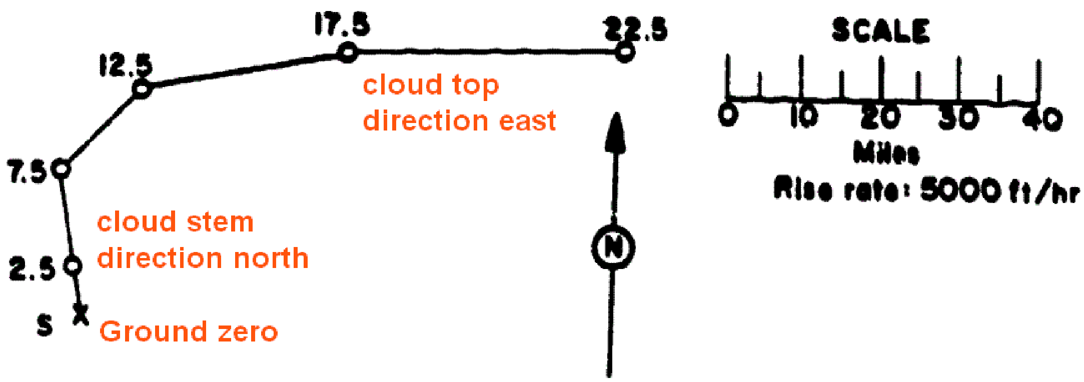


Figure 11. Hodograph for Operation BUFFALO - Round 2.

Buffalo-2 was detonated in a windshear to separate the cloud top fallout pattern from the cloud stem fallout. The stem (wind from the surface to 7.5 kft altitude) headed northwards, but the cloud top fallout headed eastward.

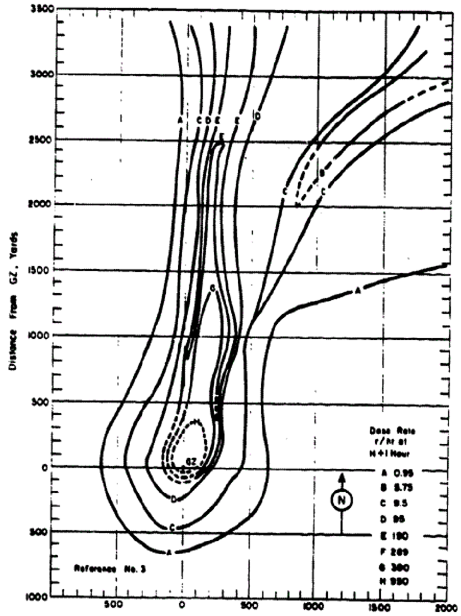


Figure 9. Operation BUFFALO - Round 2.
On-site dose-rate contours in r/hr at H+1 hour.

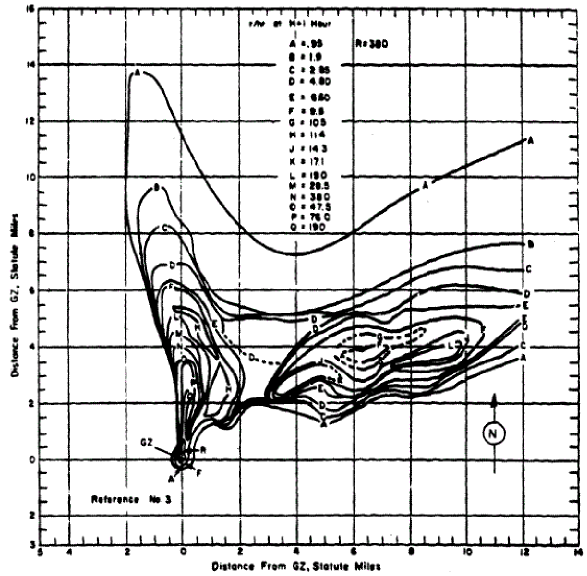
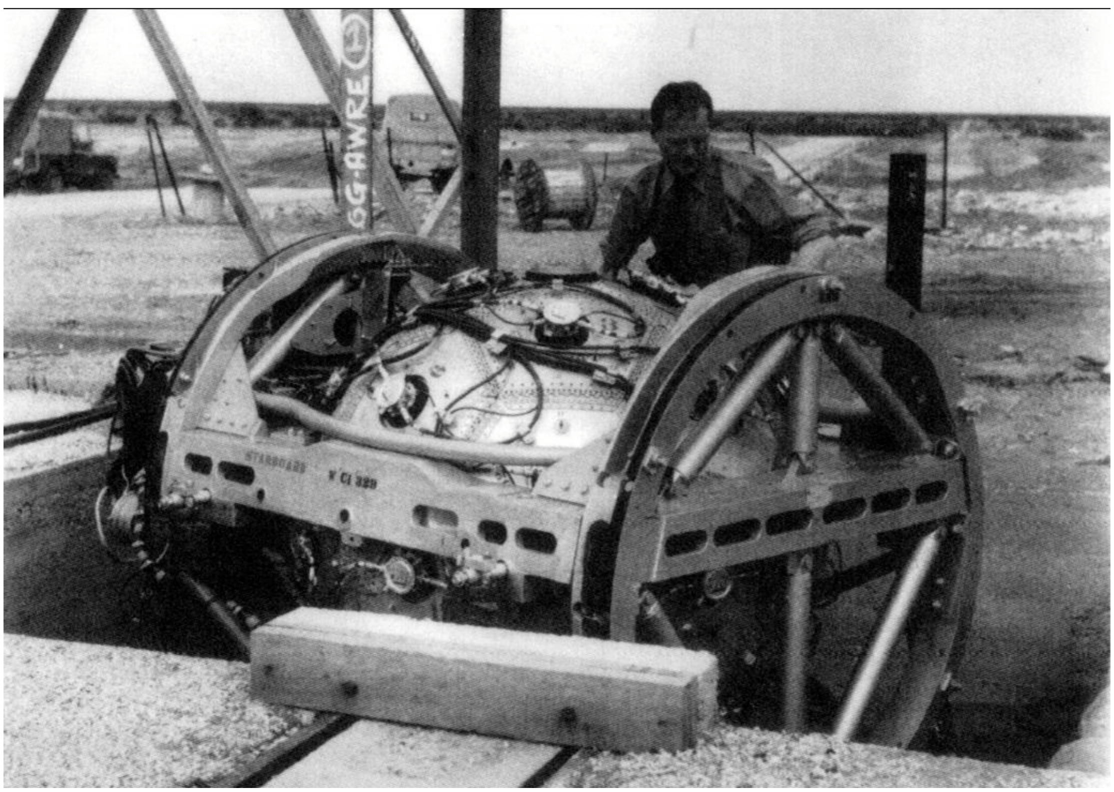


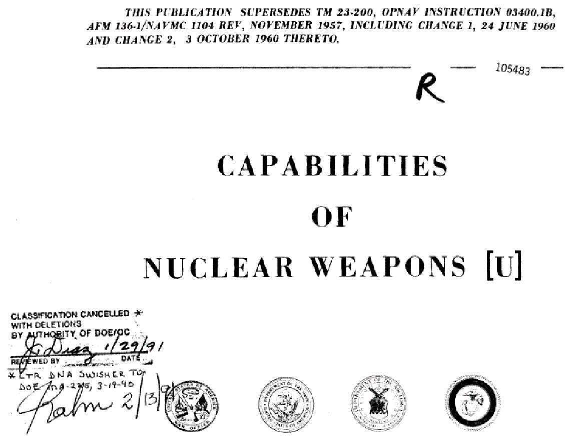
Figure 10. Operation BUFFALO - Round 2.
Off-site dose-rate contours in r/hr at H+1 hour.

Source: ADA956123

Wind shear pattern for Buffalo 2 blew the cloud stem northwards and the main cloud top eastwards, thereby allowing the fallout survey to determine the partition of the distribution of radioactivity in the cloud between the stem and the cloud top. It turned out that there was more activity in the stem than in some Pacific H bomb tests.



Buffalo 2 emplacement so that centre of bomb is located at precisely ground level (Atomic Weapons Establishment).



THIS PUBLICATION SUPERSEDES TM 23-200, OPNAV INSTRUCTION 03400.1B, AFM 136-1/NAVMC 1104 REV, NOVEMBER 1957, INCLUDING CHANGE 1, 24 JUNE 1960 AND CHANGE 2, 3 OCTOBER 1960 THERETO.

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CAPABILITIES OF NUCLEAR WEAPONS [U]

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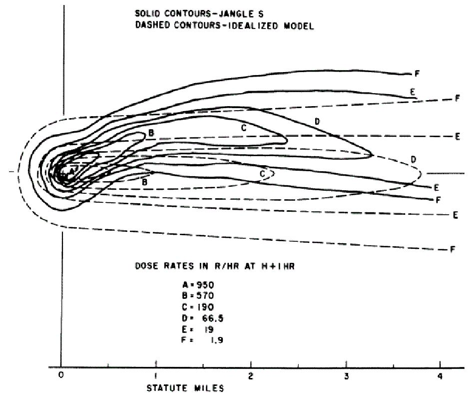

Figure 4-3. Comparison of Actual Fallout Contours with Idealized Model for a Yield of 1.2 kt and Effective Wind of 20 knots

CHAPTER 5 ELECTROMAGNETIC PHENOMENA

TYPES OF EFFECTS 5-1
ELECTROMAGNETIC PULSE PHENOMENA 5-1

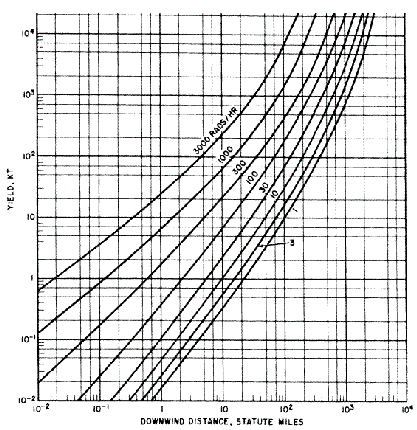

Figure 4-25. Yield vs. Downwind Distance, 40-knot Effective Wind

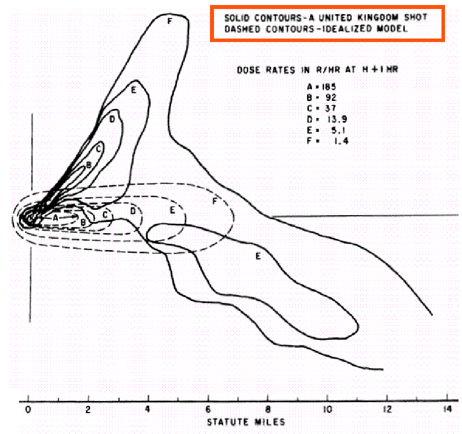

Figure 4-4. Comparison of Actual Fallout Contours with Idealized Model for a Yield of 1 kt and Effective Wind of 10 knots

British 1.4 kt BUFFALO-2 Surface burst, Maralinga (fallout from calcium carbonate)

Buffalo-2 fallout data was compared to American data in the 1964 edition of the classified American manual, *Capabilities of Nuclear Weapons.*

See also the now-declassified secret film of Operation Buffalo located at http://www.iwm.org.uk/collections/item/object/1060022261

Also the Operation Hurricane test declassified secret report, https://archive.org/stream/BritishNuclearTestOperationHurricaneDeclassifiedReportsToWinston/HurricaneNuclearTestCivilDefenceData#page/n17/mode/2up

For effects on Hiroshima and Nagasaki relevant to humanity:

https://archive.org/details/TheEffectsOfTheAtomicBombOnHiroshima

Discussion of declassified nuclear weapons effects data and its censorship by anti-civil defense, anti-deterrence biased media: http://glasstone.blogspot.co.uk/